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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/752,798	12/28/2000	Mohamed Arafa	42390P8119	9364
8791	7590	10/04/2005	EXAMINER	
BLAKELY SOKOLOFF TAYLOR & ZAFMAN			MAI, ANH D	
12400 WILSHIRE BOULEVARD			ART UNIT	
SEVENTH FLOOR			PAPER NUMBER	
LOS ANGELES, CA 90025-1030			2814	

DATE MAILED: 10/04/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

**Office Action Summary**

Application No.

09/752,798

Applicant(s)

ARAFA ET AL.

Examiner

Anh D. Mai

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 24 August 2005.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 1-5, 7-16, 18 and 19 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-5, 7-16, 18 and 19 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
  - ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

- |  |   |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892)  | 4) <input type="checkbox"/> Interview Summary (PTO-413)<br>Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)                                   | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152)             |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)<br>Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____  |

## DETAILED ACTION

### *Continued Examination Under 37 CFR 1.114*

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on August 24, 2005 has been entered.

### *Status of the Claims*

2. Amendment filed August 24, 2005 has been entered. Claims 1, 11, 15 and 18 have been amended. Claims 1-5, 7-16, 18 and 19 are pending.

### *Claim Objections*

3. Claims 15 and 18 are objected to under 37 CFR 1.75(c), as being of improper dependent form for failing to further limit the subject matter of a previous claim. Applicant is required to cancel the claim(s), or amend the claim(s) to place the claim(s) in proper dependent form, or rewrite the claim(s) in independent form.

As recites in claim 11, the implanting a dopant *through the L-shape spacer* forms the intermediate and deep source/drain region at the same time. (See Fig. 11, alternative).

Claims 15 and 18 recite: "further comprising", which means another dopant implantation. While the specification does not support a second dopant implantation through the L-shape spacer.

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Claims 15 and 18 appear to claim the invention of Fig. 6, which is not the case, because the dopant implantation of Fig. 6 does not implant "through the L-shape spacer" and the second silicon oxide film 406 has not been removed.

### *Claim Rejections - 35 USC § 112*

The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

4. Claim 18 is rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claim 18 recites: "the method of claim 17".

Claim 17 has been canceled, Claim 18 is incomplete thus, indefinite.

### *Claim Rejections - 35 USC § 103*

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

5. Claims 1-5, 7-16, 18 and 19 are rejected under 35 U.S.C. 103(a) as being unpatentable over Chern et al. (U.S. Patent No. 6,150,223) in view of Laxman et al. (U.S. Patent No. 5,976,991) and Miles (U.S. Patent No. 6,235,597) (all of record).

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With respect to claim 1, Chern teaches a method of forming sidewall spacers adjacent opposing vertical sides of a gate electrode substantially as claimed including:

forming at least one gate electrode (14) over a substrate (10);

forming a first silicon oxide film (20) conformally over the substrate (10) and gate electrode (14) from a combination of gases and oxygen at a temperature;

forming a silicon nitride film (22) conformally over the first silicon oxide film (20) from a combination of gases, at a temperature; and

forming a second silicon oxide film (24) over the silicon nitride film (22) from a combination of gases and oxygen. (See Fig. 4).

Thus, Chern is shown to teach all the features of the claim with the exception of using a specific precursor silane, temperature and pressure for the formation of the oxide and nitride layers and the duration of the deposition of silicon nitride film and implanting dopant to form source/drain regions.

Note that, the claimed pressure and the first temperature being less than the second temperature, and the duration of the deposit do not appear to be critical.

However, Laxman teaches using an alternative silane precursor such as bis-(tertiarybutylamino)silane (a.k.a BTBAS) and oxygen to form silicon oxide at 550-625 °C and a combination of BTBAS and ammonia to form silicon nitride layer at 600 °C at an pressure of approximately 20 mTorr to 1 atmosphere.

Therefore, it would have been obvious to one having ordinary skill in the art at the time of invention to form the first silicon oxide (20), silicon nitride (22) and second silicon oxide (24)

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of Chern using a precursor silane including BTBAS at temperatures and pressure as taught by Laxman because BTBAS does not contain direct Si-C bonds thus, the deposited films have very low carbon content. (See col. 5, lines 29-31).

Regarding the formation of the source/drain regions, Miles teaches: after forming a second silicon oxide film (6) over the silicon nitride film (5), an etching process is performed to remove the silicon oxide film (6) to form an L-shape spacer (5); (see Figs. 1-2); and implanting a dopant (shown as arrows) through the L-shape spacer (5) to form a region of intermediate dopant concentration and depth between a tip region (10) and a source/drain region (11). (See Fig. 3, col. 3, lines 41-62).

Therefore, it would have been obvious to one having ordinary skill in the art at the time of invention to implant dopant through the L-shape spacer of Chern as taught by Miles to form source/drain regions of a MOSFET, since it is well known that source/drain regions are required for a MOSFET to function.

Regarding the claimed pressure, the disclosed pressure of Laxman includes “approximately 20 mTorr” this pressure is considered to be closed to the claimed value.

Regarding the first temperature being less than the second temperature, Laxman clearly teaches: the deposition temperatures of silicon oxide is in the range of 550-625 °C and of silicon nitride layer at 600 °C, although the first temperature (550-625 °C) overlaps the second temperature (600 °C), however, there is no direct evidence either in the specification or the claim

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itself showing that any unexpected results had occurred. Thus, the teaching of Laxman meet the limitations of the claim.

Note that, the 600 °C of Laxman can be seen as less than and more than 600 °C.

Further, Laxman teaches: silicon oxide, silicon nitride or silicon oxynitride can be formed using BTBAS at a temperature range 500 to 800 °C and pressure range 20 mTorr to 1 atmosphere. The claimed temperature and pressure are within Laxman's teaching, thus, obvious.

Also note that, the claimed pressure and the first temperature being less than the second temperature do not appear to be critical. The specification contains no disclosure of either the critical nature of the claimed "*the first temperature being less than the second temperature*" of any unexpected results arising therefrom. Where patentability is aid to based upon particular chosen dimension or upon another variable recited in a claim, the Applicant must show that the chosen dimension are critical. *In re Woodruff*, 919 F.2d 1575, 1578, 16 USPQ2d 1934, 1936 (Fed. Cir. 1990).

Furthermore, the specification contains no disclosure of either the critical nature of the claimed *duration of 49 minutes in the deposition of silicon nitride* of any unexpected results arising therefrom. Where patentability is aid to based upon particular chosen dimension or upon another variable recited in a claim, the Applicant must show that the chosen dimension are critical. *In re Woodruff*, 919 F.2d 1575, 1578, 16 USPQ2d 1934, 1936 (Fed. Cir. 1990).

Since the deposition rate of silicon nitride is taught by Laxman to be 20 to 29 angstrom per minute, therefore, it would have been obvious to one having ordinary skill in the art at the

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time of invention to determine the duration of the deposition of the silicon nitride film as taught by Laxman to from any specific thickness which is based on the deposition rate of 20 to 29 angstrom per minute.

With respect to claim 2, forming the silicon oxide film of Chern in view of Laxman comprises providing one or more wafers in a furnace at first temperature, and flowing BTBAS and oxygen into the furnace.

With respect to claim 3, forming the silicon nitride and the silicon oxide films of Chern in view of Laxman comprises keeping the one ore more wafers in the furnace.

With respect to claim 4, forming the silicon nitride film of Chern in view of Laxman comprises maintaining the one or more wafers in the furnace at a second temperature, and flowing BTBAS and  $\text{NH}_3$  into the furnace.

With respect to claim 5, forming the second silicon oxide film of Chern in view of Laxman comprises maintaining the one or more wafers in the furnace at the first temperature, and flowing BTBAS and oxygen into the furnace.

With respect to claims 7 and 9, Official Notice is taken, that purging the furnace prior to form another different film appears to be within the ability of one having ordinary skill in the art to prevent cross-contamination.

With respect to claims 8 and 10, Official Notice is taken, that how purging preformed is within the ability of one having ordinary skill in the art including shutdown all reactant gases follow by introducing inert gas then introducing the new reactant gas.



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With respect to claim 11, Chern teaches a method of forming sidewall spacers adjacent opposing vertical sides of a gate electrode substantially as claimed including:

forming at least one gate electrode (14) over a gate dielectric layer (12B), the gate dielectric layer (12B) disposed on a substrate (10);

depositing a first silicon oxide film (20) conformally over the substrate (10) and gate electrode (14) from a combination of gases and oxygen at a temperature;

depositing a silicon nitride film (22) conformally over the first silicon oxide film (20) from a combination of gases, at a temperature;

depositing a second silicon oxide film (24) over the silicon nitride film (22) from a combination of gases and oxygen; and

forming a first sidewalls spacer. (See Figs. 2-5).

With respect to the combination of gases precursor, temperature and pressure to form silicon oxide and nitride and the duration of silicon nitride deposition, and implanting dopant, similar reasoning as that of claim 1 is also applied here.

With respect to claims 12 and 13, all films of Chern in view of Laxman are deposited in-situ in a first furnace.

With respect to claim 14, the furnace of Chern in view of Laxman comprises a vertically oriented furnace and the flow of the reactant gases into the furnace from the bottom are well known.

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With respect to claims 15 and 18, as best understood by the examiner, in view of Miles, the implanting dopant also results in forming the deep source/drain region (11) in the substrate adjacent at least two opposing sides of the gate electrode (3) or opposing side of the L-shape spacer (5).

With respect to claim 16, forming of the first sidewall spacer of Chern in view of Laxman comprises anisotropically etching the second silicon oxide film (24), the silicon nitride film (22) and the first silicon oxide film (20).

With respect to claim 19, the implanting dopant of Miles includes a partial passage of ions beam through a portion of the L-shaped spacers.

### *Response to Arguments*

6. Applicant's arguments with respect to pending claims have been considered but are moot in view of the new ground(s) of rejection.


### *Conclusion*

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Anh D. Mai whose telephone number is (571) 272-1710. The examiner can normally be reached on 9:00AM-5:00PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Wael Fahmy can be reached on (571) 272-1705. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

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Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).



**ANH D. MAI**  
**PRIMARY EXAMINER**